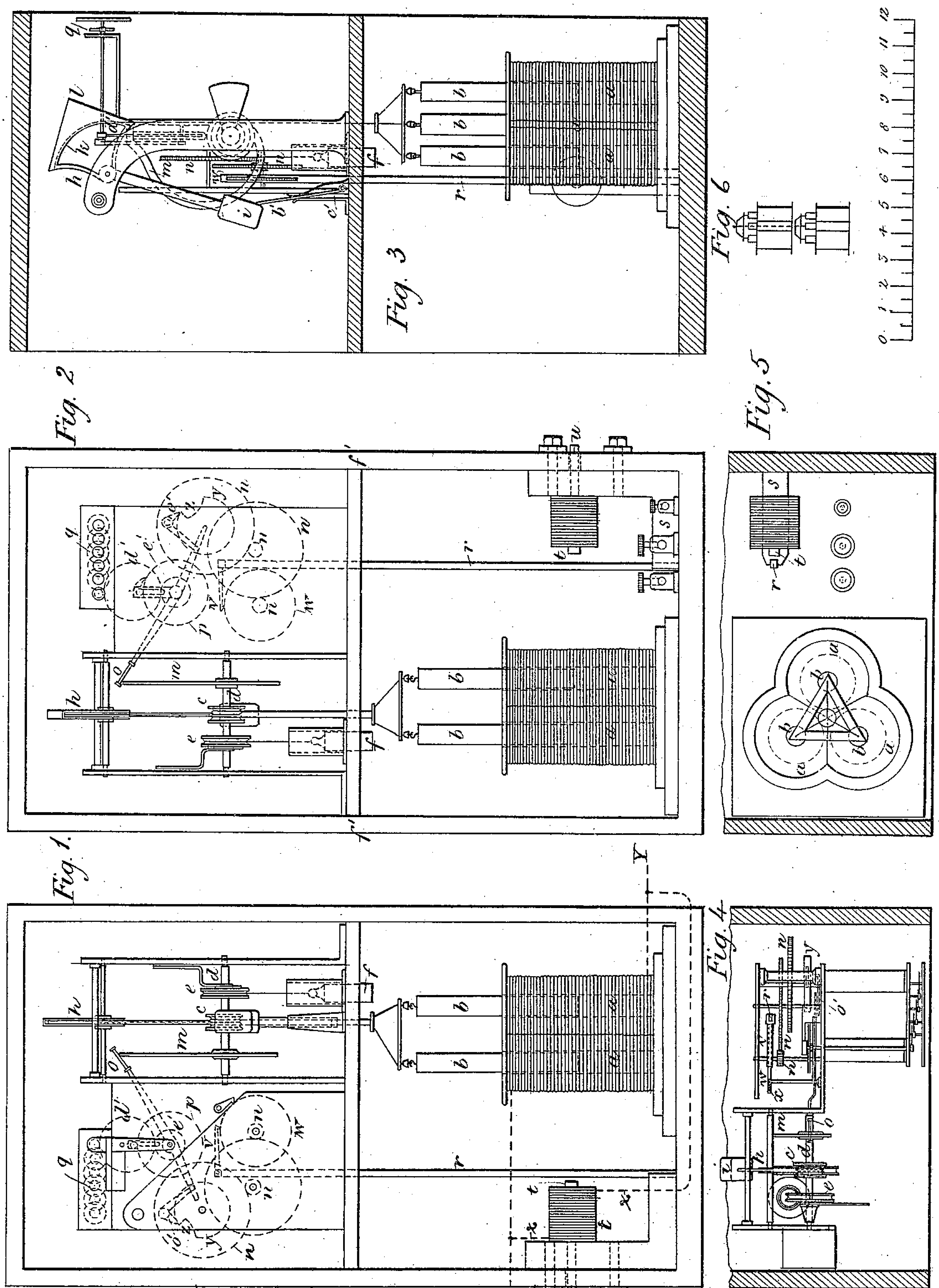
(No Model.)

J. E. H. GORDON.

ELECTRIC METER.

No. 355,871. Patented Jan. 11, 1887.



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ELECTRIC METER.

SPECIFICATION forming part of Letters Patent No. 355,871, dated January 11, 1887.

Application filed August 21, 1886. Serial No. 211,532. (No model.) Patented in England June 12, 1883, No. 2,922, and February 25, 1885, No. 2,572.

To all whom it may concern:

Be it known that I, JAMES EDWARD HENRY GORDON, a subject of the Queen of Great Britain, residing at 28 Collingham Place, Kensington, in the county of Middlesex, England, electrical engineer, have invented certain new and useful Improvements in Electric Meters, (for which I have received Letters Patent in Great Britain, No. 2,922, dated June 12, 1883, and No. 2,572, dated February 25, 1885,) of which the following is a specification.

This invention relates to improved meters for registering the quantity of electricity or of electric energy used for lighting or other purposes. In many existing meters the solenoid or galvanometer portion of the apparatus moved by the electricity has to move the registering apparatus. The necessary friction of the latter introduces errors.

In apparatus constructed according to this invention the current-indicator, solenoid, galvanometer, or electro-magnetic portion moves freely, and mechanism independently actuated moves the counter at short intervals through a distance depending on the part moved by the electricity.

The annexed drawings show the way in which I prefer to form the meter for registering alternating currents. When the meter is used for direct currents, certain alterations have to be made, which will be indicated in their proper places.

Figure 1 is a back elevation, Fig. 2 a front elevation, and Fig. 3 an end view, partly in section, of the meter. Fig. 4 is a plan view, partly in section, of the upper part of the meter; and Fig. 5, a plan view, partly in section, of the lower part. Fig. 6 shows how two sets of solenoids may be used, so that the meter may be employed for recording two separate and distinct currents.

The current to be measured passes through one, two, or more (by preference through three) solenoids, *a*, as shown, which draw into them the corresponding number of cores *b*. The object of having two, three, or more solenoids is to diminish the self-induction when alternating currents are used, as the connections are so made that the currents in the adjacent wires of neighboring coils are in opposite directions, and so assist each other by their mutual induction. The two, three, or more coils may be connected in series or parallel, as best suits the current to be measured and the wire wound on them. With direct currents this two, three, or more coil arrangement would have no particular advantage over a single coil of larger size, and consequently a single coil may be used.

The cores *b* consist of thin sheet-iron, either forming a split tube or preferably wound into a roll, so that a cross-section of the core would form a spiral, a sheet of paper or other insulator being laid on the iron sheet before rolling, so as to insulate neighboring convolutions from each other.

With direct currents a solid core may be used.

The cores are attached to a light frame and suspended by a cord or chain to a pulley-wheel, *c*, fixed on a spindle, *d*. On the same spindle is another pulley, *e*, from the edge of which a weight, *f*, is suspended, which just balances the cores when no current is passing.

From the pulley-wheel *c* a cord or chain also goes up to the short end of a lever, *h*, to the long end of which a counter-weight, *i*, is fixed. At the short end of the lever is the segment *k* of a pulley, in the groove of which the cord lies. A guard, *l*, protects it from being thrown out of the groove by any sudden jerk.

As the counter-weight is more raised it gets more leverage, (as in an ordinary postal balance,) and therefore the position in which the cores rest indicates the strength of the current.

On the same spindle, *d*, which carries the pulleys is a snail-disk, *m*. The curvature of its edge is such that the distance measured vertically downward from a certain point above it to its upper edge is always proportional to the deflecting current.

The method of drawing the curve is to fix on the spindle a circular disk faced with paper, and then to mark on it radial lines in the positions which successively come into the vertical line with successive increments of current in the solenoids. Distances proportional to the successive currents are then measured on these lines from the edge toward the center. The spiral line drawn through the points thus obtained gives the shape of the edge of the snail-disk. The longer arm of a lever, *o*, is caused by a revolving train of wheels, *n*, to fall at uniform intervals of time from its zero position to the edge of the snail-disk. When no current is passing through the solenoid, the longer arm of the lever *o* is just clear of the upper edge of the snail-disk. It will thus have practically no fall at all when no current is passing and the snail-disk not deflected, a short fall when the disk is but slightly deflected, and a long one when it is much deflected. Immediately after the fall the wheel-work *n* raises the lever-arm to its zero position, and throughout its upward journey a pawl carried by the lever engages with the teeth of a ratchet-wheel, *p*, and moves the train of counting-wheels *q* by an amount corresponding with the length of rise—that is, with the amount of current passing at the moment of the fall.

The wheel-work *n* is actuated by a vibrating iron bar, *r*, welded onto an iron block, *s*. It is kept in vibration by means of a small electro-magnet, *t*, wound with a fine wire of high resistance and connected across from the positive to the negative main. The alternations of the current in the magnet keep the rod in vibration like a tuning-fork.

In Fig. 1 the dotted line X Y may represent the main conductor. The shunt in which the magnet *t* is included may be represented by the dotted line *x*.

When the meter is used for direct currents, a make-and-break arrangement like that of an electric bell must be added.

The core of the magnet is screwed and passes through the iron block and ends in a square head at *u*. By means of a key the distance of the pole from the vibrating rod can be varied and the amplitude of vibration adjusted.

At the top of the vibrating rod is a catch, *v*, which engages the fine teeth of a ratchet-wheel, *w*, preferably constructed of hard steel. A second catch, *x*, prevents the wheel from revolving the wrong way. As long as the current from the main goes through the magnet *t* the ratchet-wheel *w* revolves at a steady and uniform rate. By means of the train of cog-wheels *n* it causes the brass disk *y* to move at a steady but much slower rate. I preferably adjust my meters so that this latter brass disk *y* revolves exactly once per ten minutes; but this is not the only useful speed. In the disk *y* is a notch, *z*, and once in each revolution the lever *o'* falls into this notch and allows the arm *o* to fall until stopped by the snail-disk *m*. When no current is passing through the solenoids, the arm *o* would still be released each minute, but would fall no distance, and therefore nothing would be indicated on the counter. As, however, it would cause unnecessary wear of the wheel-work to keep it running—for instance, all day in summer-time, when no lamps are burning—the following arrangement is adopted: The feeble current which works the vibrator passes on its way through the springs *b' c'*, (see Fig. 3,) which are so set that they tend to keep the magnet-circuit closed. When no current is passing through the solenoids, the counter-weight *i* lifts the spring *b'* out of contact with *c'*, and so stops the wheel-work. The instant that a current capable of drawing in the cores ever so little passes in the solenoids the lifting of the counter-weight allows the springs to come together and the wheel-work starts.

The first adjustment of the meter is made by varying the ratio of the two wheels *d' e'*. For instance, if a meter constructed to work at one hundred volts is wanted to work in a district where the electro-motive force is one hundred and twenty volts, the ratio of these two wheels would have to be altered. A fine adjustment can further be made by slightly altering the speed of the wheel-work by means of the key at *u*.

An escapement-wheel might be added to the wheel-work; but I prefer not to use one.

The whole apparatus is inclosed in a wooden case, *f'*. A cover is placed over the key-place *u* and secured by nuts fastened inside the case. The case is closed by a locked door, the key of which would be kept by an appointed officer. A small glass window in the door enables the consumer to see the dials.

In certain systems of electric lighting each house is supplied by two currents brought by two systems of mains, part of the lamps being on one system and part on the other. To avoid the necessity of having two meters, the following addition (shown at Fig. 6) may be made to the meter described above.

The height of the case may be increased and a second set of solenoids and cores may be placed vertically under the first. The cores will be connected to the upper cores by rods, cords, &c. If currents are sent through both sets of solenoids, the deflection of the snail-disk will be proportional to the sum of the two pulls and the meter will register according to the sum of the two currents. The meter from which the drawings have been made is suitable for about sixty to seventy lamps—*i. e.*, for a current of fifty to sixty ampères working at an electro-motive force of one hundred to one hundred and twenty volts.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. The combination of the current indicator or device, the position or condition of which is determined by the current acting thereon, and an intermittently-operating registering or recording mechanism, the extent of movement of which is regulated by the position or condition of the current-indicator, substantially as set forth.

2. The combination of the solenoid or cur-

rent-indicator, the moving part of which is independently actuated by the current passing through the indicator, an independently-operating registering device, and an interposed periodically-operated mechanism or device which at intervals searches for the position of the indicator of the electrical apparatus, and thereby causes the actuation of the registering mechanism, substantially as set forth.

3. The combination of a current indicator or device, the position or condition of which is determined by the current acting thereon, a registering or recording mechanism, a continuously-operating mechanism, and a moving device or apparatus which is periodically caused by said continuously-operating mechanism to travel through a distance regulated by the position of the moving part of the indicating device, and thereby causes the actuation of the registering mechanism.

4. The combination of a solenoid or electric indicating device, a cam or curved surface moved by it, a finger allowed to move at intervals from a zero position to the cam-surface, mechanism for periodically operating such finger, and recording apparatus for recording the sum of the lengths of all the journeys taken by said finger in its movements.

5. In an electric meter, the combination of two, three, or more solenoid or galvanometer coils so connected that the current in the adjacent wires of neighboring coils passes in opposite directions, so that the coils assist each other by their mutual induction, recording apparatus for recording at short intervals the positions in which the galvanometer-indicator is moved, and mechanism for periodically effecting the movement of the recording mechanism.

6. The combination of a galvanometer, a finger or instrument which at intervals searches for the position of the galvanometer-indicator, a vibrating rod or tuning-fork, and mechanism for periodically moving said finger, actuated by the rod or tuning-fork.

7. In an electric meter in which the recording mechanism is driven by the electric current, the combination of two contact fingers or springs normally in contact, through which the electric current for driving the recording mechanism passes, and a weight or arm lifted by the solenoid or coil of the meter whenever a current passes and is allowed to fall when no current is passing, to separate the contact-fingers and cut off the current which actuates the recording mechanism.

8. In an electric meter, the combination, with one recording mechanism and two sets of coils, each for recording the passage of separate currents, of interposed mechanism whereby the current in both coils is registered on said recording mechanism, for the purpose set forth.

9. The combination of the current indicator or device, the position or condition of which is determined by the current acting thereon, intermittently-operating registering or recording mechanism, the extent of movement of which is regulated by the position or condition of the current-indicator, actuating mechanism by which the registering devices proper are intermittently operated, and automatic circuit completing and breaking devices, which when a current is flowing automatically start such actuating mechanism into operation and upon the cessation of the current automatically stop it.

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Witnesses:

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